Contributions of Urban, Biomass Burning and Secondary Organic Aerosols at the T1 Site during MILAGRO 2006

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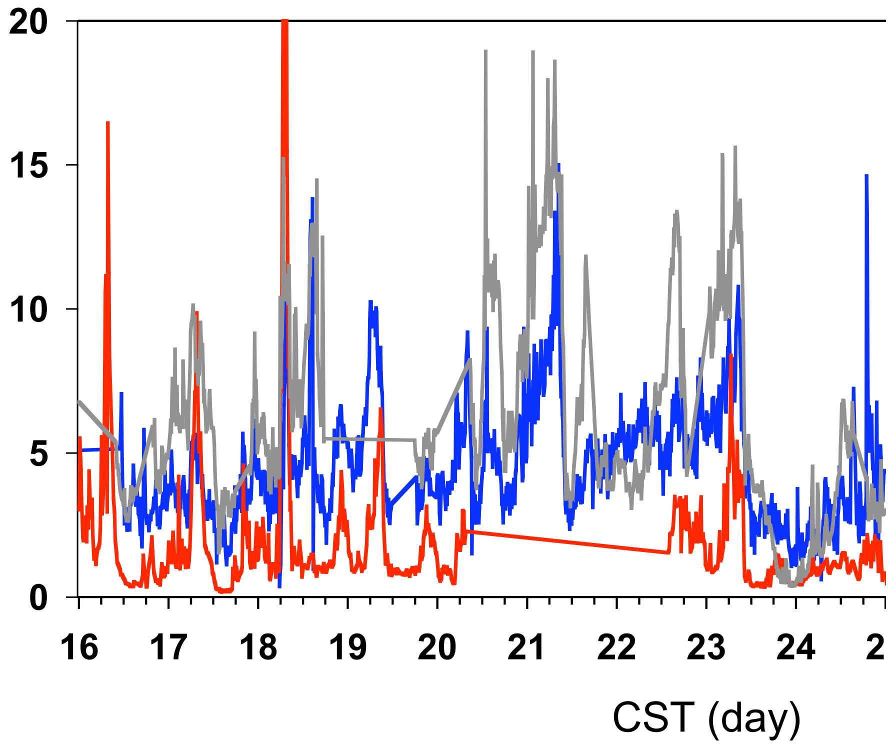
Motivation

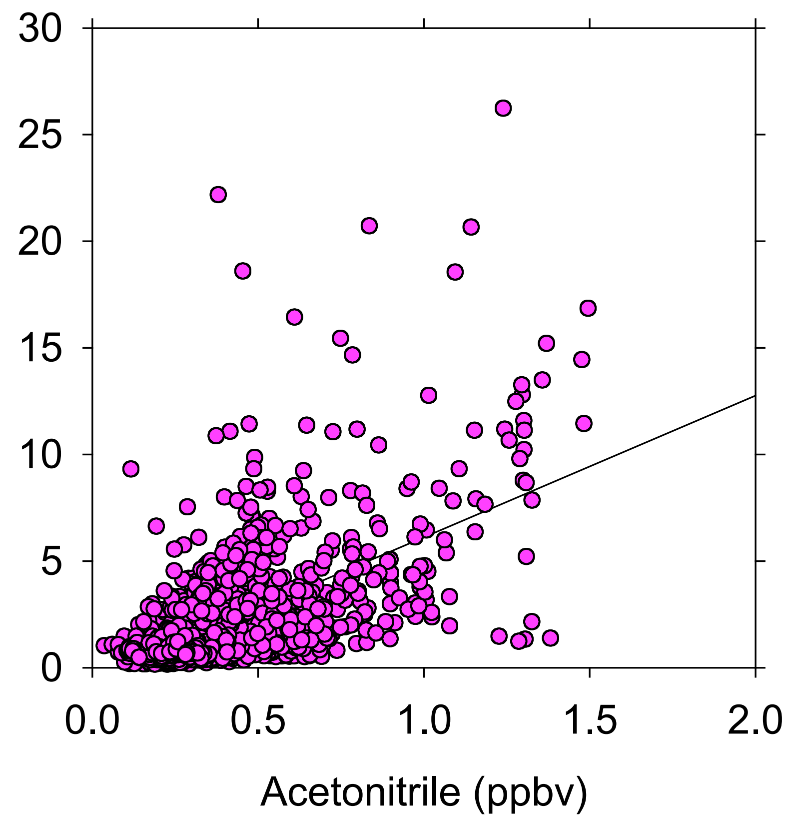
- Organic aerosols (OA) observed were of three major types:
  - POA from urban sources
  - BBOA from fires (e.g., grass, trees, trash)
  - SOA from urban, biogenic, and biomass burning precursor VOCs
- Contributions of the different types of OA are needed to estimate radiative forcing by each type
- Breakdown by each type is also needed to carry out meaningful model analyses of POA, BBOA, and SOA evolution

Analysis Approaches

- Positive Matrix Factorization (PMF)
  - Uses m/z OA mass spectrum time series
  - Needs error statistics for each m/z
- Multiple Linear Regression (MLR)
  - Uses independently measured tracers
  - Needs background concentrations

T1 Site Data





Acetylene → Urban POA tracer

Acetonitrile → BBOA tracer

Poor correlation between the tracers is needed for MLR to work

Multiple Linear Regression (MLR) for OA

$$[OA] = \text{Ä}[BBOA] + \text{Ä}[POA] + \text{Ä}[SOA] + [OA]_{bkg}$$

Multiple Linear Regression (MLR) for CO

CO has only two major primary sources: Biomass Burning and Urban

$$[CO] = \Delta[CO]_{BB} + \Delta[CO]_{urban} + [CO]_{bkg}$$

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Background Concentrations & MLR Results

$[CH_3CN]_{bkg}$ = 0.2 ppbv

$[C_2H_2]_{bkg}$ = 0.3 ppbv

$[OA]_{bkg}$ = 5.96 $\mu g\ m^{-3}$

$[CO]_{bkg}$ = 197.5 ppbv

$x_{OA} = \Delta[BBOA]/\Delta[CH_3CN] = 9.4 \pm 1.5\ \mu g\ m^{-3}\ ppbv^{-1}$

$y_{OA} = \Delta[POA]/\Delta[C_2H_2] = 0.43 \pm 0.06\ \mu g\ m^{-3}\ ppbv^{-1}$

$x_{CO} = \Delta[CO]_{BB}/\Delta[CH_3CN] = 427 \pm 21$ ppbv/ppbv

$y_{CO} = \Delta[CO]_{Urb}/\Delta[C_2H_2] = 144 \pm 2$ ppbv/ppbv

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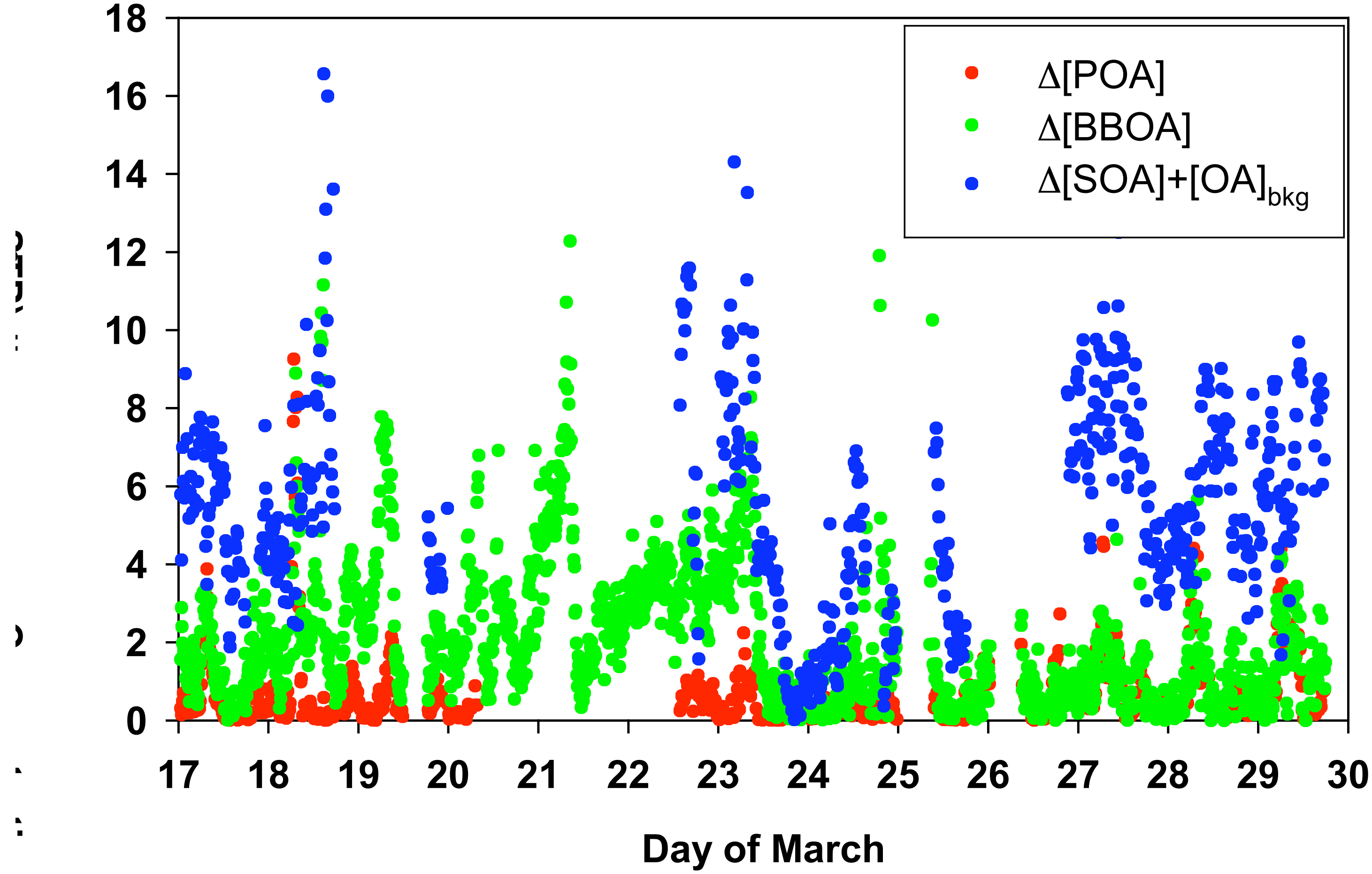
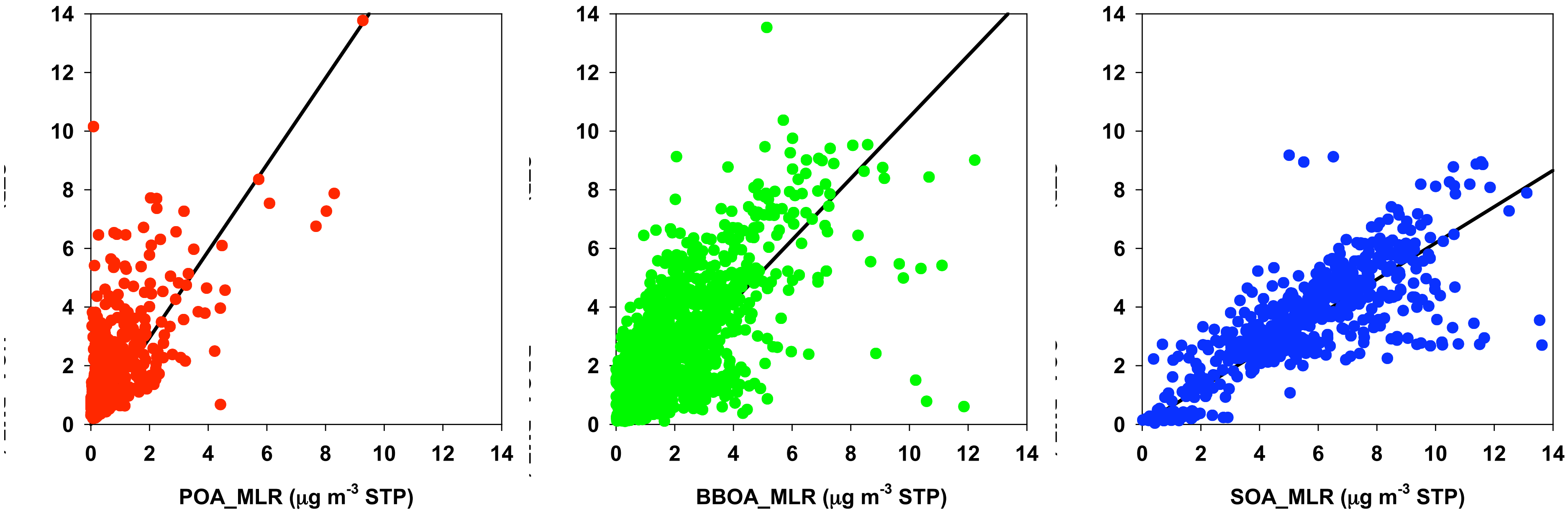
Estimated POA, BBOA, and SOA by MLR



PMF vs MLR



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Emission Ratios: Estimated vs Inventory

Emission Ratios in g/kg

Emission Ratio	MLR (this work)	Measurement	WRF-chem Inventory
$\frac{\Delta[BBOA]}{\Delta[CO]}$	18±4	**80-220** (Pine fires: Yokelson et al., 2007) ~17 (Grass fires: Sinha et al., 2004)	~70
$\frac{\Delta[POA]}{\Delta[CO]}$	2.4±0.4	~3.3 (Kirchstetter et al., 1999 de Gouw et al., 2005)	3.8

BBOA/CO ratio at T1 is consistent with grass fires as opposed to pine forest fires. The $^{13}C/^{12}C$ analysis of Marley et al. (2008) also confirms that T1 was impacted by local grass fires (i.e., C-4 plants).

BBOA/CO ratio in WRF-Chem inventory is consistent with pine forest fire data of Yokelson et al. (2007).

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